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RENOVATION OPERATION AND MAINTENANCE OF THE NRL (NAVAL
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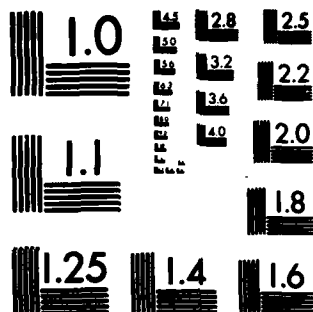
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RENOVATION, OPERATION, AND MAINTENANCE
OF THE NRL MICROWAVE AND MILLIMETER WAVE
TUBE FABRICATION AND ASSEMBLY FACILITY

20 February 1983

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Final Report
for
Contract N00173-80-C-0432

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RENOVATION, OPERATION, AND MAINTENANCE
OF THE NRL MICROWAVE AND MILLIMETER WAVE
TUBE FABRICATION AND ASSEMBLY FACILITY

ABSTRACT

This report summarizes activities and accomplishments under Contract N00173-80-C-0432 (BKD C1229) during the period September 1, 1980 through December 31, 1982.

All of the goals set for this contract have been met. The Tube Fabrication and Assembly Facility is operational, providing the Naval Research Laboratory with an in-house capability for the construction, modification, or repair of microwave tubes and associated components and devices. Technical information, data sheets, and specifications regarding performance characteristics of tubes/components fabricated in the Facility have been provided to the Naval Research Laboratory staff upon delivery of the items themselves. A manufacturers' catalog file was established to provide a convenient and consistent source of information during the design phase of a microwave tube or device. Original Facility equipment has been repaired, replaced, or refurbished as best as possible considering the age and condition of the equipment at the beginning of this contract. A vacuum firing and brazing system was acquired, and other processing and test equipments were designed and constructed. A detailed description of the results obtained from this contract is given in the following sections:

1. Fabrication and Assembly Facilities
2. Mechanical Design and Fabrication
3. Components and Materials
4. Documentation and Training.



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1.0 FABRICATION AND ASSEMBLY FACILITIES

1.1 Hydrogen Furnace

- Operating procedures were modified to eliminate internal rusting.
- The Hydrogen Electrodryer was reactivated and is now ready for use.
- Furnace doors, baffles, and sprockets were reset and lubricated. Some bushings had started to rust from lack of lubrication.
- The power relays were replaced with new, higher current capacity relays.
- The high current wiring was replaced.
- A new temperature indicator/controller, and a new thermocouple, were ordered and installed.

1.2 RF Induction Heater and Bell Jar

- Hydrogen and water lines were replaced, leaky valves repaired, electric contacts cleaned.

1.3 Chemistry Lab

- A water deionizer was installed.
- The small sink has been replaced with a large tub.
- A hot bath ultrasonic cleaner was put into service.
- Protective and functional plating were installed.

1.4 Clean Room

- Two laminar flow assembly benches were cleaned and placed in the room designated as the Clean Room.
- The small spotwelder was cleaned, reset, and placed in the Clean Room.
- Glass desiccators using Silica Gel were put back in service for parts storage in the Clean Room.

- A small vacuum pump was obtained along with two vacuum desiccators for vacuum storage of cathodes.
- A small (3-inch diameter) diamond wheel driven by a variable high speed motor was housed in a plastic enclosure for use in trimming and cutting ceramics.

1.5 Equipment

- A thermocouple gauge was acquired because of large discrepancies in temperature measurements using existing gauges. It was found that some gauges were 200 degrees off at 800 degrees.
- A bakeout oven, 2 ft x 2 ft x 8 ft, was designed and constructed. The oven has built-in variacs capable of controlling 5 kilowatts of electrical power plus thermocouples and gauges for monitoring temperatures at 24 locations.
- A potting and encapsulating system was designed and constructed to permit the encapsulating and sealing of high voltage terminals used on microwave tubes.
- A new high vacuum system and bell jar was acquired to provide vacuum firing and brazing capability. All internal electron gun parts are now vacuum fired, and stainless steel parts are being successfully brazed without the need for nickel or copper plating.
- A portable high vacuum pump was acquired for general use in processing or in test.
- A small bakeout oven was acquired, refurbished, and installed.
- A high temperature air oven was acquired and installed.

2.0 MECHANICAL DESIGN AND FABRICATION

2.1 Completed

- Mechanical design; detail and assembly drawings; parts manufacture, processing, and assembly of a gyrotron gun designed by Dr. J. M. Baird.
- Mechanical design; detail and assembly drawings; parts manufacture, processing, and assembly of a gyro traveling wave tube. The electron gun was designed by Dr. S. Ahn and the RF circuit by Mr. N. Vanderplaats.
- Completion of parts and assembly of an electron beam analyzer designed by Dr. L. Barnett.

- Construction of a backfill manifold for Dr. L. Barnett.
- Construction and assembly of a high power collector assembly for Dr. J. Levine.
- Repair and reassembly of the electron gun for a double-ring-bar TWT.
- Location and modification of a 5 KV, 1 ampere electron gun for slow wave structure experiments conducted by Dr. L. Barnett.
- Mechanical design; detail and assembly drawings; parts manufacture; processing and assembly of the electron gun designed by Mr. A. Dudas for the quasi-optic tube designed by Drs. D. Kim and M. Read.
- Assembly of a window on an 8-inch diameter vacuum flange for Dr. D. Kim.
- Assembly of a beryllium oxide RF window for Dr. J. Levine.
- Assembly of the mini thermocouple junctions for a calorimeter used by Code 4740.
- Final machining of the .005-inch diameter holes for a 240 GHz RF coupler used by Dr. J. Silverstein.

2.2 In Process

- Due to problems with parts supplied by outside vendors, the electron gun designed by Dr. J. M. Baird had to be redesigned so that all parts could be manufactured at NRL. This version, Mod II, is in final assembly.
- An electron beam heating system for use with the vacuum bell jar has been designed and is now awaiting the delivery of a 3-kilowatt transformer.
- An electroforming technique for making large metal-ceramic vacuum joints is being evaluated for the gyro-klystron designed by Dr. B. Arfin.
- The mechanical design and detail drawings for the gyro-klystron designed by Dr. B. Arfin are complete. Parts are being ordered.
- The trim coil for the gyro-TWT designed by Mr. N. Vanderplaats is being wound.
- Mechanical design of the dual-taper gyro-TWT designed by Mr. N. Vanderplaats is completed. Parts common to the single-taper gyro-TWT are on hand. Detail parts drawings will start as soon as the first gyro-TWT is delivered to test.

- Detail drawings were made and parts manufactured for a helical solenoid designed by Dr. R. Jackson. Magnet wire has been received and winding will start in 1983.
- Assistance in the mechanical design, detail, and assembly drawings, and parts manufacture for a megawatt tube designed by Dr. M. Read was provided to Code 4740. Parts are being received; processing and assembly will be started in 1983.
- The quasi-optic electron gun delivered in 1982 was damaged during RF tests and returned for repair. New parts were made, and the repair should be completed early in 1983.
- An RF radiation detector is awaiting process in the small bakeout oven.
- An electron gun used by Dr. J. Silverstein is being evaluated to determine if the open heater can be repaired.

3.0 COMPONENTS AND MATERIALS

- Alumina and machinable ceramics were acquired for firing and assembly use.
- Molybdenum, Nickel, OFHC Copper, and 304 Stainless were acquired from various sources.
- Braze alloys were identified and consolidated.
- Feed-thrus and metalized ceramics were acquired from various sources and consolidated.
- High voltage silicone wire was acquired for general use.
- Surplus microwave tubes and components were acquired for parts and for test purposes. Some parts have already been put to use, one tube is being used in test, and other components are being designed into new tubes.

4.0 DOCUMENTATION AND TRAINING

4.1 Seminars

A weekly series of seminars was held in 1981 to give technicians a broad survey of construction techniques used in the assembly of microwave tubes.

A technical data book was started and its main sections form the subject matter of the seminars. These sections now include:

- Properties of Materials
- Basic Physics
- Basic Electricity and Magnetism
- Conversion Factors
- Brazing
- Spotwelding
- Dielectrics
- Thermocouples
- Cathodes
- Vacuums
- Traveling Wave Tubes
- Cleaning Specifications
- Plating Specifications
- Firing Specifications
- Detail Specifications
- Tools

Data sheets and specifications covering the subject were handed out at these seminars. The master copies of these sheets are now on file for duplication and issuance to anyone having an interest or need.

4.2 Numbering and Filing System

A numbering and filing system was established for prints and drawings generated or used at NRL in the design or construction of microwave tubes.

4.3 Catalog File

A catalog file was established containing data and information on manufactured parts, assemblies, and services provided by manufacturers and representatives. Information can be accessed by either the name of the organization or the product.